CHAPTER ONE NEW MEXICO: A Geographical Description

New Mexico is characterized by high mountains, extensive plains and plateaus, and river gorges and broad valleys. Figure 1 locates New Mexico with reference to her neighbors and shows the principal towns, drainage systems, and road networks. The climate of the State is arid to semiarid. Average annual precipitation ranges from less than eight inches in desert valleys to over 30 inches in the mountains. About half the annual precipitation is received during brief but intense summer storms. Much of the winter precipitation falls as snow in the high mountains and as snow or rain at lower elevations. Statewide, the annual average precipitation is much less than evaporation from open water surfaces (**1**). Land surface elevations in New Mexico vary from just over 13,000 feet in the northern mountains to just under 3,000 feet at the Texas border in the southeast.

New Mexico is the fifth largest of the fifty states, with a total area of almost 122,000 square miles. Of this total, 34.2 percent are federal lands, 11.8% are State lands, 9.4% are Native American lands, and 44.6% is privately owned. In 1982, about 84 % of all land in New Mexico was used for grazing (**2**). Just over 80% of non-federal New Mexico land was used for pasture and rangeland in 1982, while urban and built-up land constituted about 1.25% of the State's non-federal land area (**3**). In 1992, pasture and rangeland occupied about 82% of all land (**4**). Cropland uses about 3.3% of all land of which about 56% of that amount was used for irrigated agriculture (**16**).

From a count of just over 1.3 million in 1980, the population increased 2.75 percent due to migration from out-of-State, and 13.5% from in-State natural increase (births minus deaths) to a 1990 total of just over 1.5 million people (**5**). The population is expected to reach about two million within the next fifteen years (**6**). Despite a rapid rate of increase compared to the nation, the State remains sparsely settled overall.

Population centers are associated with available surface and ground water. While some communities are located over large underground aquifers, the environmentally sensitive river valleys and flood plains, which often contain shallow aquifers, are foci for population density (**3**). Albuquerque, on the Rio Grande near the center of the State, is by far the largest city. Containing one-third of the total State population within its metropolitan area, it is more than six times larger than either of the next two cities in size, Las Cruces near the Texas border to the south and Santa Fe to the north.

New Mexico has a small and relatively poor regional economy. Services and tourism is the leading non-agricultural employment sector, followed closely by all branches of government. Retail trade is the third largest employer, and manufacturing is fourth providing just over six percent of jobs. The federal government provides over 4.5% of the State's employment and has a large defense and research presence in the State. New Mexico also has a diversified natural resource extraction industry (**7**, **8**, **15**). Some researchers argue that the federal presence is actually much larger than figures originating with the New Mexico Department of Labor presented above might suggest. These researchers reason that active duty service personnel, defense plant employees, and workers at the two national laboratories should be included in the federal sector. At present many of these workers are either not included in the statistics, or are classified in other sectors. Using multipliers to estimate indirect impacts as well, one researcher estimates the federal presence between thirty and thirty-five percent of employment (**6**).

In New Mexico, the State estimates that there are approximately 6,000 miles of perennial rivers and streams. EPA has issued a preliminary estimate of 110,741 miles of rivers streams, ditches and canals for New Mexico. Of these, 8,682 are classified perennial, 99,332 miles as intermittent, and 2,727 as ditches or canals (**9**). New Mexico estimated the length of its perennial streams by the use of a map wheel on a full set of United States Geological Survey's (USGS) 1:24000-scale topographic maps. Only the cartographic symbols for perennial stream were used; no intermittent or ephemeral streams, ditches or canals were included. EPA relied on its *Reach File 3* (RF3) database, created from the USGS's Digital Line Graph (DLG) database. This dataset was in turn developed from 1:100000-scale maps. The difference in map scales may account for much of the difference in total perennial stream lengths. Additionally, since the two agencies may have used maps which may have been updated from satellite or aerial photos taken at different times, potentially at different times of the year, there is further reason to believe the estimates might differ (**9**).

The State has identified approximately 175 freshwater, publicly accessible lakes and reservoirs, approximately fifty of which are over 200 acres in area. According to EPA's preliminary estimate, New Mexico has 1,256 lakes (**9**).

Figure 2 shows the State's eleven water quality basins. New Mexico's surface waters include headwater portions of three of the nation's principal drainage systems: drainage from the San Juan River Basin and Lower Colorado River Basin contributes to the Colorado River; drainage from the Arkansas-White-Red River Basin contributes to the Mississippi River; and the three Rio Grande basins and the Pecos River Basin contribute discharge to the Gulf of Mexico. Other streams in the State are in topographically closed basins and drain internally (**10**).

Total annual stream flow averages over 5.7 million acre-feet, of which precipitation falling within the State boundaries contributes 3.3 million acre-feet. Other states, principally Colorado via the Rio Grande and the San Juan River, contribute the rest. Downstream states receive 3.6 million acre-feet from New Mexico (**1**).

The quality of surface waters varies from place to place. Generally, water originating in the high mountains is of excellent quality. At lower elevations, water is usually of lesser quality. High

quality water is subjected to degradation as it flows downstream due to evapotranspiration, evaporation, anthropogenic pollutant loading, and its application to beneficial uses. Background information on surface waters is provided in **Appendix A**.

New Mexico's hydrogeology is highly variable and complex, and the quality and availability of ground water also varies from place to place. Sedimentary deposits (mainly sandstone, limestone, or unconsolidated sand and gravel) are the most productive aquifers. Valley-fill aquifers of major importance occur along the Rio Grande, the Rio Chama, the San Juan and Pecos Rivers. These aquifers are typically less than 200 feet thick and commonly provide water containing less than 1,000 milligrams per liter of total dissolved solids. A major basin-fill aquifer occurs in the Rio Grande Valley where basin-fill deposits attain thicknesses of up to 20,000 feet. This aquifer provides the source of water for Albuquerque and a partial source for Santa Fe. The High Plains basin-fill aquifer (primarily Ogallala formation) is a major water source along the eastern border of New Mexico. The Ogallala formation, the boundaries of which are roughly from Nebraska to New Mexico, is an example of a shared water source where states need to coordinate their efforts in terms of ground water pollution. Major sandstone aquifers are located in the San Juan Basin in the northwestern part of the State, and limestone aquifers are of importance in the southeastern part and locally in the central and western parts.

Many aquifers are highly vulnerable to contamination from surface discharges. Maintenance of surface water quality is necessary to protect the State's ground water quality. The key risk factor for aquifer contamination is a shallow water table combined with a significant point or non-point source of pollution. In the urban areas of our state, abandoned, unplugged domestic wells (such as in Las Cruces and the South Valley in Bernalillo county) also add to the vulnerability to contamination. Other factors affecting ground water vulnerability include preferential flow pathways, clay and organic matter content of soils, and oxidation-reduction potential. The location and relative vulnerability of New Mexico aquifers are shown in Figure 3 (**11**).

The magnitude of ground water supplies in the State is estimated to be 20 billion acre-feet. Of this amount, an estimated three billion acre-feet of fresh water and 1.4 billion acre-feet of slightly saline water are recoverable. In some areas with significant ground water use, ground water levels have declined due to withdrawals in excess of recharge (**1**).

The State's surface water supply is almost fully applied to beneficial uses under existing rights or reserved for specified beneficial uses under water rights filings. In order to protect existing ground water rights from impairment, 32 underground water basins, have been 'declared' by the State Engineer (**12**, **13**).

Water uses depend on both surface and ground water supplies. In 1990, total surface and ground water withdrawals totaled 4.2 million acre-feet and depletions (that portion of withdrawals permanently removed from the water supply) amounted to almost 2.6 million acre-feet. Of these totals, agriculture, excluding reservoir and stock pond evaporation, accounted for 3.4 million acre-feet (80%) of withdrawn water and just under two million acre-feet (75%) of the depletion. Public and private water supply wells extracted approximately .3 million acre-feet in 1990, and so accounted for only eight percent of total withdrawals. Ground water comprised 89% of the public and private water withdrawals and of agricultural withdrawals. The relative distribution of water uses can be expected to change in future years, as the growing sectors of the economy and an increasing population exert continued demands on this limited resource (**14**).

FIGURE 1. MAP OF NEW MEXICO

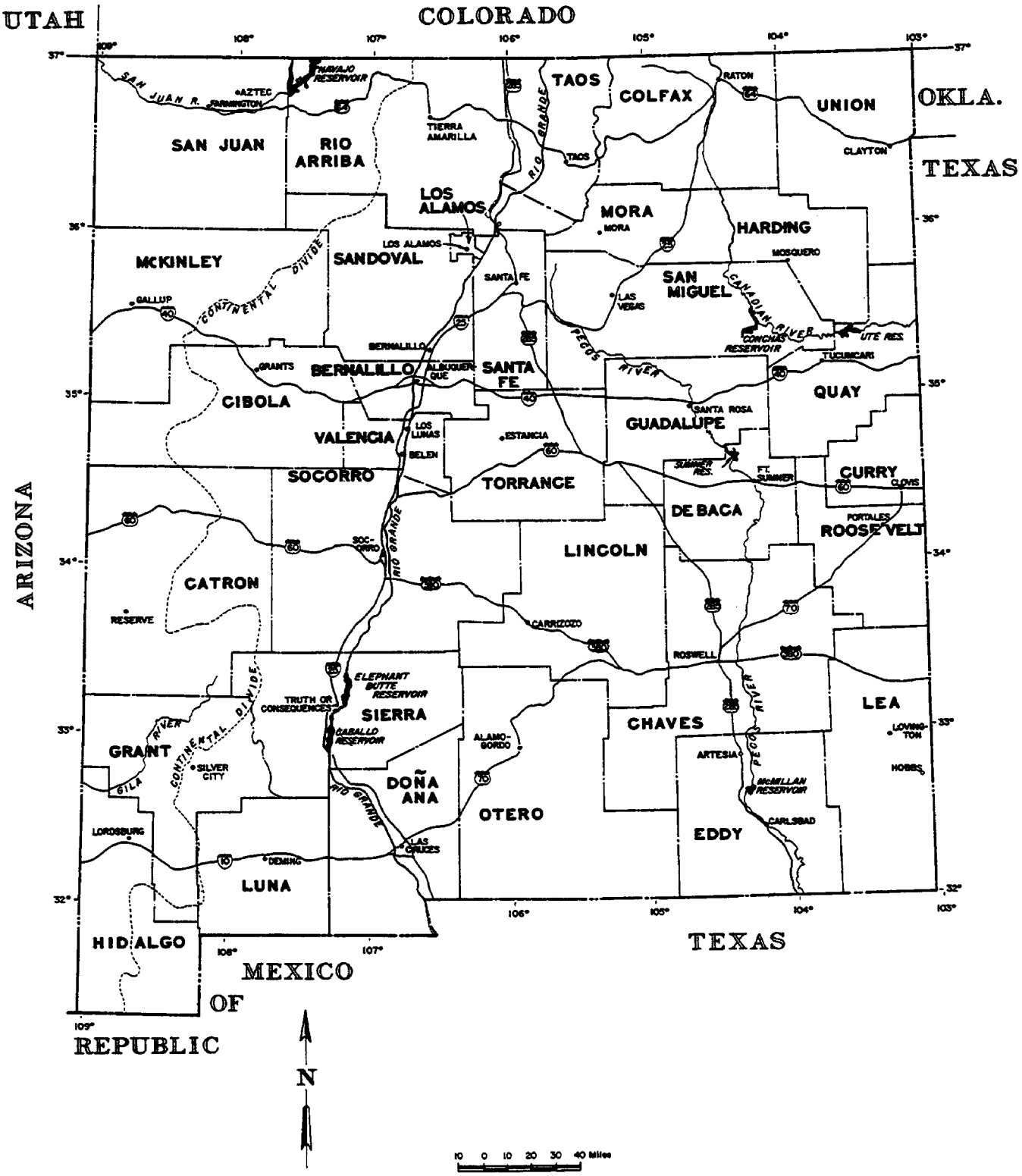


FIGURE 2. WATER QUALITY BASINS IN NEW MEXICO

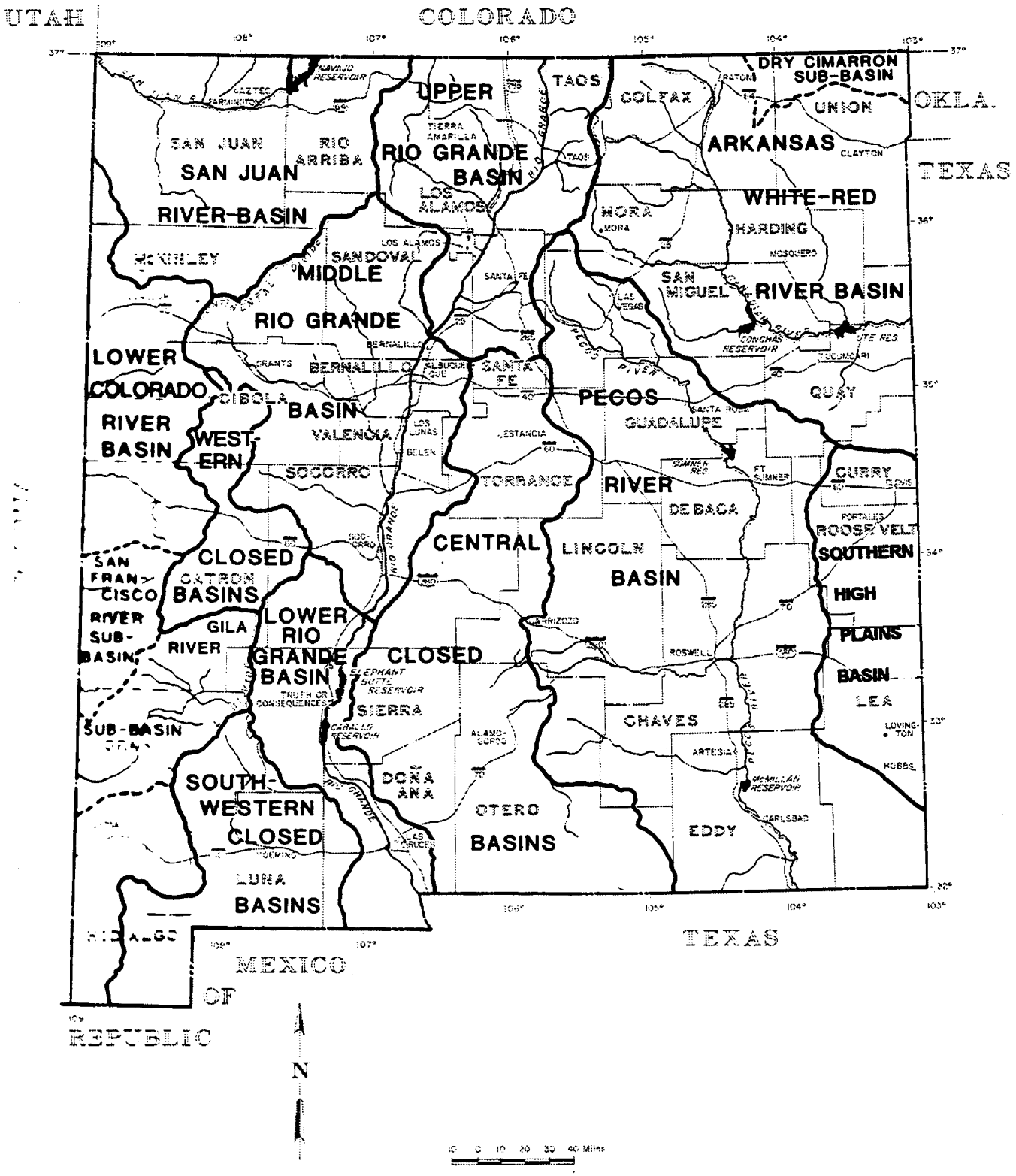
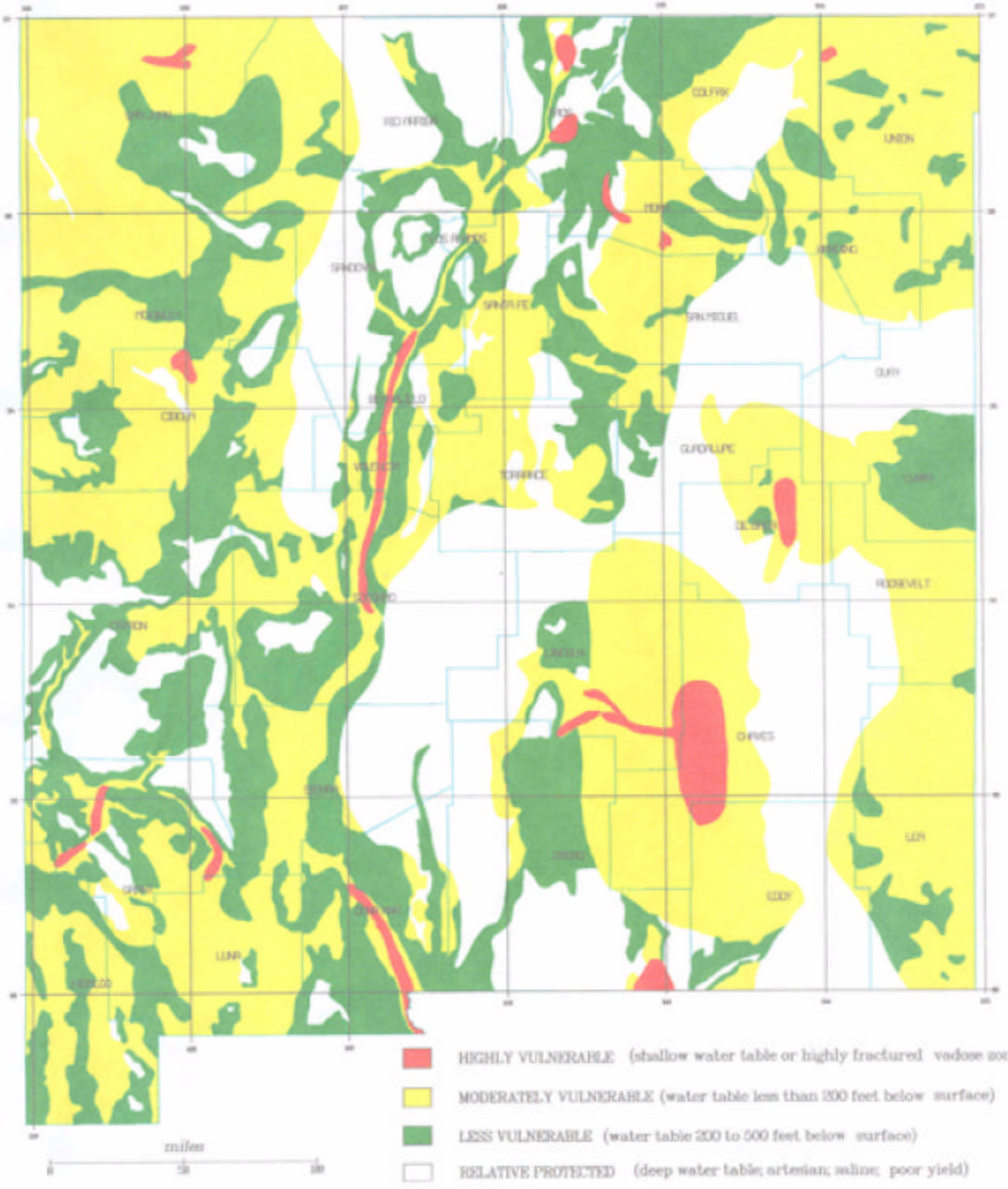


Figure 3. RELATIVE VULNERABILITY OF NEW MEXICO AQUIFERS TO CONTAMINATION FROM SURFACE DISCHARGES



Digitized from Lee Wilson & Associates, March, 1979 by N.M Water Resources Research Institute, NMSU, June 1993.

United States Department of the Interior

1) 1976 Bureau of Reclamation in cooperation with the State of New Mexico. *New Mexico State resources assessment for planning purposes*. 218 pages.

2) 1986 New Mexico Soil and Water Conservation Division. *New Mexico soil and water conservation plan*. Santa Fe, New Mexico. 22 pages.

Jerry L. Williams

3) 1986 *New Mexico in Maps*. Second Edition. University of New Mexico Press. Albuquerque, New Mexico. 177 pages.

United States Department of Agriculture

4) 1992 New Mexico Agricultural Statistics Service. *New Mexico Agricultural Statistics, 1992*. Las Cruces, New Mexico. 72 pages.

University of New Mexico

5) 1991 Alcantara, Adelamar. *New Mexico's Population in the 1990's. Continuing an era of slow growth*. Bureau of Business & Economic Research. Albuquerque, New Mexico. 31 pages.

6) 1990 Bureau of Business & Economic Research. Demographic Analysis and Projection Service. *Population and employment projections for New Mexico Counties 1990-2010*. Albuquerque, New Mexico. 75 pages.

7) 1993 Bureau of Business & Economic Research. *New Mexico Business; Current Economic Report.* Vol. 14, No. 10. November, 1993. Albuquerque, New Mexico. 10 p.

8) 1989 McDonald, Brian. *New Mexico economy: Review and outlook*. Bureau of Business and Economic Research. Albuquerque, New Mexico. 17 pages.

United States Environmental Protection Agency

9) 1993 Office of Water. *Total Waters Estimates for United States Lakes and Streams*. Monitoring Branch. Assessment and Watershed Protection Division Office of Wetlands, Oceans and Watersheds.

New Mexico Water Quality Control Commission

10) 1974 *Basin Plans*. Series of publications for each of the eleven WQCC-designated stream -1976 basins in New Mexico. Santa Fe, New Mexico. {See References for Chapter Two for individual document citations.}

Lee Wilson & Associates

11) 1979 *Program for the statewide monitoring of ground water quality in New Mexico: File report for the NM Environment Improvement Division*. Albuquerque, New Mexico. 180 pages.

New Mexico State Engineer Office

12) 1995 *Annual report of the New Mexico State Engineer Office*. Fiscal year 1995, July 1, 1994 to June 30, 1995. Santa Fe, New Mexico. 97 pages.

13) 1989 *Special order No. 142 declaring the Curry County underground water basin in Curry County*. Santa Fe, New Mexico. 2 pages.

14) 1992 Wilson, Brian. *Water Use by Categories in New Mexico Counties and River Basins and Irrigated Acreage in 1990*. Technical Report 47, July, 1992. Santa Fe, New Mexico. 141 pages.

New Mexico Economic Development Department

15) 1993 *New Mexico USA Fact Book*. Santa Fe, New Mexico. 162 pages.

New Mexico State University

16) 1992 Lanceford, Robert. *Sources of Irrigation Water and Irrigated and Dry Cropland in New Mexico by County 1990 - 1992*. Agricultural Experiment Station, Cooperative Extension Service, College of Agriculture and Home Economics. Technical Report 16. Las Cruces, New Mexico.